The Geophysical Approach for the Wilcox Refinery Level of Effort (LOE) 6-30-15 document provides a good overview of the rationale for the work to be performed, the time needed, and the cost estimate. I am aware of a few of the geophysicists noted in the document and understand them to be competent and capable. Below I detail a few thoughts and comments in my review of the document.

It makes sense to have a seismic team, but the EM31 and EM61 may not warrant two separate teams (unless of course there are 4 instruments). The operation of these EM instruments requires one person per instrument and then maybe 2 people max to "guide" the data acquisition people along the correct line and prepare the next line. Hence, there would be a seismic team and an EM team. The EM31 and EM61 data acquisition will walk the same lines, so the line locations are the same for these instruments. However, it is very important that when acquiring the data each instrument is separated by enough distance to eliminate possible instrument interference.

I agree a 20 year old seismograph is generally not a good idea. There are too many uncertainties with data quality and instrument stability, especially if the instrument is not regularly used and maintained. If it has been used regularly and has good data quality, then it should be fine. I have used a 20+ year old Geometrics Strataviewer which works great; but it is used frequently and is well maintained. It is typically not the seismic instrument that degrades, rather it is the wires, take out cables, and particularly the trigger cable and switch.

Different EM31 and EM61 instruments collecting data on the same site will likely generate dissimilar absolute data that will need to be leveled if they are to be combined into one grid. This issue is mostly observed with the EM31; but both instruments require a calibration. The different calibration procedures/techniques per instrument and different operators (mostly due to different operator height) will yield different absolute data; but similar relative data. This variability is readily observed in the results. It is best to try and use the same instrument and the same operator throughout the survey. If this is not possible, then procedures should be noted, and planned, for calibration and data correction/leveling.

The LOE 6-30-15 document states, the bulk of the EM data will be profiles acquired along roads and old trails. It is not clear how this acquisition will be useful to achieve the objectives. It seems unlikely that leftover foundations or tanks are located buried under roads and trails. If the survey is performed along the road then utilities may be observed; however they may not be EM anomalies as the surveys will be parallel to the roads and utilities are typically buried parallel to the road. The EM surveys might pick up utilities crossing orthogonal to the road; but this depends on the road conditions. It is important to note that these EM instruments are not utility, tank, or foundation detectors. They measure the electromagnetic properties of the earth below their survey location. There are three fundamental EM properties of matter; electrical conductivity, magnetic permeability, and relative permittivity. An EM property contrast within the earth is required to detect any EM anomalies, which might be due to a utility, foundation, or tank. If surface conditions (i.e., road) exhibit high EM property values then it will mask the response from deeper objects. This is typical of roads and the EM response. If site conditions prohibit a grid type survey, then that is the reality of the site; but an EM grid survey would likely investigate the site in a more inclusive manner and better serve the EM survey objectives. If possible, I encourage the development of an acquisition grid. It is not unusual for a site such as this to require a week of grid set up, then a week (or less) of EM data collection. The grid set up could likely be the largest effort.

The MASW field procedures are correct. However, I am not fully convinced this is the best and only method to achieve the objectives. I trust there has been some thought on this matter and I am coming late to the discussion, so that is fine. In my opinion, an induced polarization (IP) survey done in concert with the MASW would yield less uncertainty in the results and provide a different geophysical measurement as converging lines of evidence to achieve the objectives. Furthermore, IP surveys (and the resistivity that one collects with it) have been shown to delineate contaminant plumes of various types and degrees of degradation, so this may also help to guide direct push/well/sample locations. Of course, this would cost more and the budget might preclude this possibility. Has there been any forward modeling for the MASW survey? This is an excellent (and highly recommended) method to predict expected results and determine field acquisition parameters. Perhaps it has been performed since the geophone spacing and shot spacing was noted. It might be interesting to look at the models, if they exist, or maybe the acquisition parameters were determined through back of the envelope calculations. A forward model could also be generated for resistivity and IP to test its utility and acquisition details.

I found nothing in the document about data quality controls or data quality objectives. How will these determined? How will it be shown the data are of sufficient quality and the instruments performed properly throughout the survey? How will the EM instruments (in particular the EM31) be calibrated (the instrument manuals provide a detailed procedure) and how will these calibrations be documented? How will the data be processed? Will there be site geologic or hydrogeologic controls placed into the inversion models to constrain the model fit? Does the LOE cost include data processing and interpretation?